

## Bird Communities in the Parks and Squares of Budapest

By

L. SASVÁRI

**Abstract.** Bird census was conducted in 10 parks of various size through 3 years, and the number of species, number of individuals, diversity and equitability were estimated. The census was based on the individual bird feeding in the area in breeding and winter season.

70 species were feeding in the parks during the 3 years' survey (1975–1977), 59 species in breeding season, 42 species in winter and 31 species as permanent ones, both in winter and breeding period. The species best adapted to the urban conditions are as follows: *Streptopelia decaocto*, *Corvus frugilegus* (in winter) *Turdus merula*, *Sturnus vulgaris*, *Phoenicurus ochruros*, *Passer montanus*, *Passer domesticus*, *Columba livia domestica*, at times and in places *Coloeus monedula*, *Parus major*. Significant positive correlation between the park size and the number of species as well as the number of individuals, and significant negative correlation between the park size and the number of individuals per hectare was found. Relying on the census the expected number of the bird species and individuals of the parks to be established in the future as a function of park size could be stated.

### Introduction

Just as the cities and industrial settlements are gaining larger and larger areas at the loss of the natural environment, can the rapid adaptation of some bird species be observed. The recent ornithological literature clearly reflects the wide interest aroused by this process, whereas the first written comments were published as early as in the last century. Besides the great number of short papers even comprehensive studies and books have been published on the settlement of the birds in cities and towns.

A brief historical survey could be begun with MARSCHALL and PELZEN'S (1882) work on the bird fauna of Vienna, however the city together with its wide natural environment was examined. PATRIZI – MONTORO (1909) already studied the birds of Rome in the narrower area of the city, and RITCHIE (1920), in his work written on the effect of man exerted on the fauna, similarly dealt with the effects of the cities and towns. SCHNURRE (1921) discussed this phenomenon as well. MACPHERSON (1929) concentrated his ornithological investigations in Lon-

\*Dr. Lajos Sasvári, ELTE Állattudományi és Ökológiai Tanszék (Zoosystematical and Ecological Institute of the Eötvös Loránd University), 1088 Budapest, VIII. Puskin u. 3.



don on the downtown district of the city. Advancing in time, the following works may be mentioned: LEGENDRE (1930) published a book on the birds of Paris, FRIELING (1942) on the ones of the German towns and cities, FITTER (1949) once more on the ones of London and ENGSTRÖM (1956) on the ones of Stockholm. LUNIAK, KALBERCZYK and PAWLOWSKI (1946) wrote an extensive study on the birds of Warsaw, and shorter papers were published on the bird fauna of Budapest (KEVE, 1976), Helsinki (KAJOSTE, 1961) and Berlin (GRIMM, THEISS, 1972). Out of the works dealing with the birds of the larger extra-European cities the following ones should be mentioned, indicating the cities in question: Chicago (Park, Burgess, MCKENZIE, 1925), Bangkok (HERMS, 1950), Singapore (WARD, 1968) and Tucson (EMLEN, 1974).

As the number of observations was increasing, theories were constructed concerning the adaptation processes of the birds to the urban environment. (LUNIAK, 1964; ERZ, 1966; SCHNURRE, 1921; GLADKOW, 1958; STRAWINSKI, 1968, etc.). The complexity of the phenomenon is truly reflected by numerous discussions of the present time and thus render the survey of the literature more and more difficult.

Studying the settlement of the birds in cities, the most important aim is to acquire knowledge on the conditions, by which the scanty remains of nature can be preserved even in the great metropolises. It seems that the historical tendency that humanity should dwell in a chain of megalopolises bordering on one another cannot be escaped; consequently, the circumstances which keep the birds even in the big cities must be ensured artificially. Again, this can be attained only by establishing squares and parks, only in this way can a suitable vegetation be formed which ensures permanent possibilities of settling even for less adaptive birds. Therefore, the purpose of the present study was to compare the bird density and species diversity on the parks and squares of different sizes, so that through this some proposal could be suggested regarding a healthy forming of the future cityscapes.

## Method

### *The study areas*

Ten study areas were chosen from the periphery towards the central district, so that all characteristic squares and parks of Budapest should be included. The parks were surrounded by closely built, several stories high houses and building estate as well as by industrial plants without vegetation, excepting the Cemetery Park situated in the periphery and being the largest one. Its outskirts were bordered by a young acacia forest and arable fields.

The tree and shrub species in the parks and squares of Budapest are listed as follows:

#### Vörösmarty Square

Tree species: *Platanus acerifolia*, *Tilia argentea*.

Shrub species: *Euonymus europaeus*, *Ligustrum vulgare*, *Staphylea pinnata*.



## Vigadó Square

Tree species: *Abies alba*, *Betula pendula*, *Picea pungens*, *Robinia pseudoacacia*.

Shrub species: *Euonymus europaeus*, *Ligustrum vulgare*, *Philadelphus coronarius*.

## József Nádor Square

Tree species: *Acer negundo*, *Celtis occidentalis*, *Tilia argentea*.

Shrub species: *Ligustrum vulgare*, *Philadelphus coronarius*, *Picea pungens*.

## Engels Square

Tree species: *Acer campestre*, *Acer platanoides*, *Aesculus hyppocastanum*, *Ailanthus glandulosa*, *Betula pendula*, *Catalpa bignonioides*, *Celtis occidentalis*, *Fraxinus excelsior*, *Platanus acerifolia*, *Robinia pseudoacacia*, *Salix alba*, *Salix japonica*.

Shrub species: *Berberis vulgaris*, *Cercis siliquastrum*, *Cornus alba*, *Cornus sanguinea*, *Eleagnus agnustifolia*, *Ligustrum vulgare*, *Syringa vulgaris*.

## Museum Park

Tree species: *Acer platanoides*, *Aesculus hyppocastanum*, *Catalpa bignonioides*, *Celtis occidentalis*, *Fraxinus excelsior*, *Platanus acerifolia*, *Robinia pseudoacacia*, *Sophora japonica*, *Tilia cordata*.

Shrub species: *Cornus alba*, *Cornus sanguinea*, *Cotoneaster dammeri*, *Eleagnus agnustifolia*, *Ligustrum vulgare*, *Taxus baccata*.

## Friendship Park

Tree species: *Acer campestre*, *Acer platanoides*, *Aesculus hyppocastanum*, *Betula pendula*, *Celtis occidentalis*, *Pinus nigra*, *Populus alba*, *Populus euramericana*, *Populus italica*, *Robinia pseudoacacia*, *Salix alba*, *Sophora japonica*.

Shrub species: *Berberis vulgaris*, *Cercis siliquastrum*, *Coletea arborescens*, *Cornus alba*, *Cornus sanguinea*, *Cotoneaster horizontalis*, *Crataegus crus-galli*, *Crataegus monogyna*, *Eleagnus agnustifolia*, *Gleditsia triacanthos*, *Ligustrum vulgare*, *Lonicera caprifolium*, *Lonicera tatarica*, *Malus pumila*, *Morus alba*, *Padus avium*, *Rhus typhina*, *Ribes aureum*, *Robinia pseudoacacia*, *Rosa gallica*, *Rosa tomentosa*, *Quercus robur*, *Salix alba*, *Salix caprea*, *Salix purpurea*, *Sambucus nigra*, *Sorbus aucuparia*, *Sorbus domestica*, *Spiraea japonica*, *Spiraea pumila*, *Staphylea pinnata*, *Symphoricarpos orbicularis*, *Symphoricarpos racemosus*, *Syringa vulgaris*, *Syringa persica*, *Tamarix gallica*, *Taxus baccata*, *Thuja occidentalis*, *Thuja orientalis*, *Viburnum lantana*, *Viburnum opulus*, *Vinca minor*, *Wistaria chinensis*, *Yucca filamentosa*.

## Margaret Island

Tree species: *Abies alba*, *Acer campestre*, *Acer negundo*, *Acer palmatum*, *Acer platanoides*, *Acer rubrum*, *Acer sacharum*, *Acer tataricum*, *Aesculus hyppocastanum*, *Aesculus pariflora*, *Ailanthus glandulosa*, *Alnus glutinosa*, *Amorpha fruticosa*,



*Amygdalus nana*, *Amygdalus triloba*, *Betula alba*, *Carpinus betulus*, *Catalpa bignonioides*, *Cedrus atlantica*, *Celtis occidentalis*, *Chamaecyparis Lawsoniana*, *Corylus avellana*, *Corylus colurna*, *Cydonia oblonga*, *Fagus silvatica*, *Fraxinus americana*, *Fraxinus excelsior*, *Fraxinus ornus*, *Juglans nigra*, *Juniperus communis*, *Koeleruteria paniculata*, *Malus baccata*, *Malus floribunda*, *Malus pumila*, *Morus alba*, *Padus avium*, *Picea excelsa*, *Pinus montana*, *Pinus mungo*, *Pinus nigra*, *Pinus silvestris*, *Pinus strobus*, *Platanus acerifolia*, *Populus alba*, *Populus canadensis*, *Populus italica*, *Populus tremula*, *Prunus avium*, *Prunus fruticosa*, *Prunus mahaleb*, *Quercus cerris*, *Quercus robur*, *Robinia pseudoacacia*, *Salix alba*, *Salix caprea*, *Salix purpurea*, *Sophora japonica*, *Tilia argentea*, *Tilia cordata*, *Tilia platyphyllos*, *Ulmus laevis*, *Ulmus minor*, *Ulmus montana*.

Shrub species: *Azalea japonica*, *Berberis thunbergii*, *Berberis vulgaris*, *Betula alba*, *Buddleia Davidii*, *Buddleia variabilis*, *Campsis radicans*, *Cercis siliquastrum*, *Chaenomeles japonica*, *Clematis montana*, *Colutea arborescens*, *Cornus mas*, *Cornus sanguinea*, *Cornus stoloriphora*, *Cotinus coggygia*, *Cotoneaster dammeri*, *Cotoneaster horizontalis*, *Cotoneaster microphylla*, *Cotoneaster tomentosa*, *Crataegus crus-galli*, *Crataegus monogyna*, *Cytisus albus*, *Cytisus austriacus*, *Eleagnus angustifolia*, *Gleditsia triacanthos*, *Hibiscus syriacus*, *Ilex aquifolium*, *Kerria japonica*, *Ligustrum vulgare*, *Ligustrum ovalifolium*, *Liliodendron tulipifera*, *Lonicera japonica*, *Lonicera litida*, *Lonicera pileata*, *Lonicera tatarica*, *Lycium halimifolium*, *Magnolia obovata*, *Magnolia soulangiana*, *Mahonia aquifolium*, *Rhus typhina*, *Robinia pseudoacacia*, *Rosa gallica*, *Rosa multiflora*, *Rosa polyantha*, *Rosa tomentosa*, *Salix caprea*, *Salix purpurea*, *Sambucus nigra*, *Sorbus aria*, *Sorbus aucuparia*, *Sorbus domestica*, *Sorbus torminalis*, *Spiraea media*, *Spiraea japonica*, *Spiraea pumila*, *Staphylea pinnata*, *Syringa persica*, *Syringa vulgaris*, *Tamarix gallica*, *Tamarix tetrandra*, *Taxodium distichum*, *Taxus baccata*, *Thuja occidentalis*, *Thuja orientalis*, *Viburnum lantana*, *Viburnum opulus*, *Vinca minor*, *Vitis silvestris*, *Wistaria chinensis*, *Yucca filamentosa*.

## City Park

Tree species: *Acer campestre*, *Acer palmatum*, *Acer platanoides*, *Acer saccharum*, *Aesculus hyppocastanum*, *Betula pendula*, *Celtis occidentalis*, *Fagus silvatica*, *Fraxinus excelsior*, *Fraxinus ornus*, *Juglans nigra*, *Malus floribunda*, *Malus pumila*, *Malus silvestris*, *Morus alba*, *Padus avium*, *Picea abies*, *Pinus nigra*, *Pinus silvestris*, *Pinus strobus*, *Platanus acerifolia*, *Populus alba*, *Populus italica*, *Quercus robur*, *Robinia pseudoacacia*, *Salix alba*, *Salix caprea*, *Sophora japonica*, *Tilia cordata*, *Tilia platyphyllos*.

Shrub species: *Berberis vulgaris*, *Cercis siliquastrum*, *Colutea arborescens*, *Cornus alba*, *Cornus sanguinea*, *Cotoneaster dammeri*, *Cotoneaster horizontalis*, *Crataegus crus-galli*, *Crataegus monogyna*, *Cytisus nigricans*, *Eleagnus angustifolia*, *Gleditsia triacanthos*, *Hibiscus syriacus*, *Laburnum anagyroides*, *Ligustrum vulgare*, *Lonicera caprifolium*, *Lonicera tatarica*, *Rhus typhina*, *Ribes aureum*, *Robinia pseudoacacia*, *Rosa gallica*, *Salix caprea*, *Sambucus nigra*, *Sorbus aucuparia*, *Sorbus aria*, *Spiraea pumila*, *Staphylea pinnata*, *Symphoricarpos orbicularis*, *Symphoricarpos racemosus*, *Syringa vulgaris*, *Syringa persica*, *Tamarix gallica*, *Taxus baccata*, *Thuja occidentalis*, *Thuja orientalis*, *Viburnum lantana*, *Viburnum opulus*, *Vinca minor*.



## People's Park

Tree species: *Acer campestre*, *Acer platanoides*, *Acer sacharum*, *Aesculus hyppocastanum*, *Amorpha fruticosa*, *Catalpa bignonioides*, *Celtis occidentalis*, *Corylus avellana*, *Corylus colurna*, *Fagus silvatica*, *Fraxinus excelsior*, *Fraxinus ornus*, *Ginkgo biloba*, *Gymnocladus dioica*, *Juglans nigra*, *Morus alba*, *Morus pyramidalis*, *Padus avium*, *Pinus nigra*, *Pinus mugo*, *Pinus silvestris*, *Platanus acerifolia*, *Populus alba*, *Populus italica*, *Populus tremula*, *Prunus avium*, *Quercus cerris*, *Quercus robur*, *Robinia pseudoacacia*, *Robinia monophylla*, *Robinia hispida*, *Salix alba*, *Salix caprea*, *Salix matsuda*, *Sophora japonica*, *Tilia cordata*, *Tilia platyphyllos*, *Ulmus laevis*.

Shrub species: *Amorpha fruticosa*, *Cercis siliquastrum*, *Colutea arborescens*, *Cornus mas*, *Cornus sanguinea*, *Cotoneaster dammeri*, *Cotoneaster tomentosa*, *Crataegus monogyna*, *Euonymus europaeus*, *Gleditsia triacanthos*, *Hybiscus syriacus*, *Ligustrum vulgare*, *Lonicera japonica*, *Rhus typhina*, *Ribes aureum*, *Robinia pseudoacacia*, *Rosa gallica*, *Sambucus nigra*, *Sorbus aucuparia*, *Syringa vulgaris*, *Tamarix gallica*, *Taxus baccata*, *Thuja orientalis*.

## Cemetery

Tree species: *Acer campestre*, *Acer platanoides*, *Aesculus hyppocastanum*, *Amorpha fruticosa*, *Celtis occidentalis*, *Fagus silvatica*, *Fraxinus excelsior*, *Fraxinus ornus*, *Pinus nigra*, *Platanus acerifolia*, *Populus alba*, *Populus italica*, *Quercus robur*, *Robinia pseudoacacia*, *Salix alba*, *Tilia argentes*, *Ulmus laevis*.

Shrub species: *Berberis vulgaris*, *Betula pendula*, *Colutea arborescens*, *Cornus mas*, *Cornus sanguinea*, *Cornus stolonifera*, *Cotinus coggygria*, *Cotoneaster tomentosa*, *Crataegus monogyna*, *Eleagnus angustifolia*, *Ligustrum vulgare*, *Mahonia aquifolium*, *Rhus typhina*, *Robinia pseudoacacia*, *Rosa gallica*, *Salix alba*, *Salix caprea*, *Sambucus nigra*, *Spiraea media*, *Syringa vulgaris*, *Tamarix tetrandra*, *Taxus baccata*, *Thuja occidentalis*, *Viburnum lantana*, *Vitis silvestris*.

## Bird census in breeding season

The census was based on the individuals of the birds feeding in the parks. It would have led to a faulty evaluation of the parks if the number of species and individuals of the birds breeding really in the parks had been recorded exclusively. If so, the birds nesting in the immediate vicinity of the parks would not have been included into the survey, although their breeding there was ensured by the open feeding area of the parks. Their presence and numbers were thus determined by the parks, although they built their nests in the neighbouring houses and factories or in the yards of these. This relationship existed especially in small downtown squares. Besides, numerous individuals of territorial species did not nest and did not hold territories either, notwithstanding that at breeding time they stayed in the parks permanently.

In all parks the transect method, that is the traversing registration was adopted for the census. Decreasing the errors caused by the moving of the birds to a minimum, in the parks of larger extent the shortest possible time had to be expended on the survey. Where there was no extensive continuous foliage, the minimum area of registration was a 100 m range of sight in the traversing, thus 200 m could be covered on the two sides. Where the tree foliage or shrubbery



was continuous, the width of the area covered to the right and left was 25 m each, i. e. 50 m. In the practice this meant that proceeding at the border of the clump of trees in the parks, the marginal area of the grove as well as the neighbouring clearing or meadow could be looked over, and in the same grove also an inside way had to be covered which led through the middle under the continuous foliage. The observed species and numbers of individuals were directly registered in the sketch map of the park. The collaborators helped to acquire authentic data even from extensive study areas. From the middle of April to the middle of June the census took place between 6.00 and 11.00 on 8–10 occasions in each park in a way that the survey of one large park took 2–3 hours (excepting the Cemetery). The number of species and individuals was calculated by the mean values of the surveys.

### *Bird census in winter*

The method of registration agreed with the transect method applied in breeding season, still with the difference that within the clump of trees the limit of sight was 50 metres on each side. Census took place in each parks on 8–10 occasions during one winter in January and February. Also the census was based on the individuals bird feeding in the area.

Bird diversity was calculated relying on SHANNON–WEAVER's formula —  $H' = - \sum p_i \ln p_i$  where  $p_i$  is the proportion of the individuals of  $i$  species to the total number of the individuals. Equitability was calculated by the  $J = \frac{H'}{H_{\max}}$  formula, where  $H_{\max} = \ln S$  ( $S$  = the number of species).

## Results

70 species were feeding in the 10 study parks, 59 of them in breeding season, 42 in winter and 31 species were permanent ones feeding there both in breeding season and in winter during the 3 years' census. In the small squares of the centre of Budapest, where also the vegetation was poor, only the commonest species, the domestic pigeon, the house sparrow, collared turtledove, and the blackbird were constant in winter and in breeding season. The tree sparrow stayed permanently only in the larger parks of more extensive vegetation. (Friendship Park of 22 hectares was the smallest one where they were.) The number of nesting species was raised by the house martin, the starling and the great tit, further in one year by the jackdaw in the larger squares (Engels Square, Museum Park). With the increase of the vegetation and with the enlargement of the park area the number of species increased conspicuously (Fig. 1). The increasing was somewhat moderated in winter, if only for the reason that the winter guest birds slightly increased the number of species in the small downtown squares; and the number of species in the large parks significantly decreased on account of the absence of the nesting migratory birds (Fig. 2). The detailed data are included in Table 1 and 2, the mean values, diversity and equitability is presented in Table 3.



Figure 1.

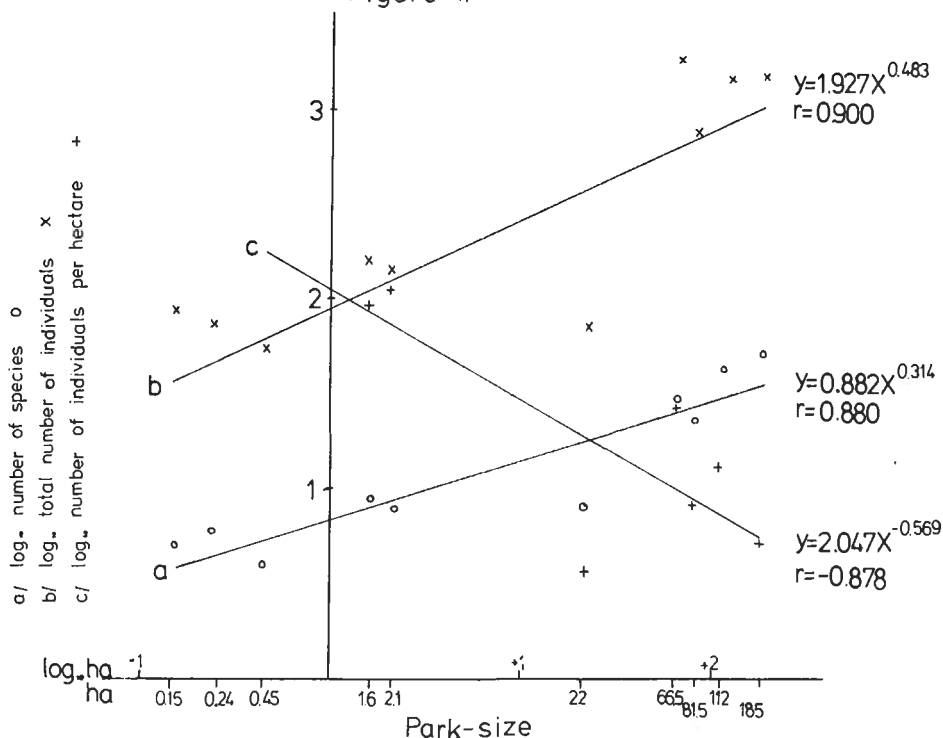


Fig. 1. Logarithmic relationship between the park size and the number of species (a), the total number of individuals (b) and the number of individuals per hectare (c) in breeding season

The number of individuals of the birds rose parallel with the increase of the parksize (Fig. 1). In winter the higher number of individuals can be ascribed both in the downtown squares and in the large parks to the presence of the rooks and fieldfares (Fig. 2). Apart from these the house sparrow and the blackbird were concentrating both on the smaller squares and on the large parks from the neighbouring areas in higher proportion than in breeding season. This concentration was more moderate in the larger parks, and fluctuated in the succession of years.

Gradually proceeding from the small squares to the large parks, the number of individuals per hectare decreased (Fig. 1, 2). The negative correlation between the number of individuals per hectare and the park size can be attributed mainly the house sparrow and domestic pigeon in compliance with the phenomenon mentioned above that concentration is rising in the areas of the small downtown squares and decreasing in the larger parks. In winter, although the number of individuals increases in all squares and parks, the rooks feed mainly in the large parks, and increasing the number of individuals per hectare, they moderate the negative correlation.

In general, a higher number of species was concomitant with a higher diversity in breeding season and in winter alike. The highest numbers of species, the



Figure 2.

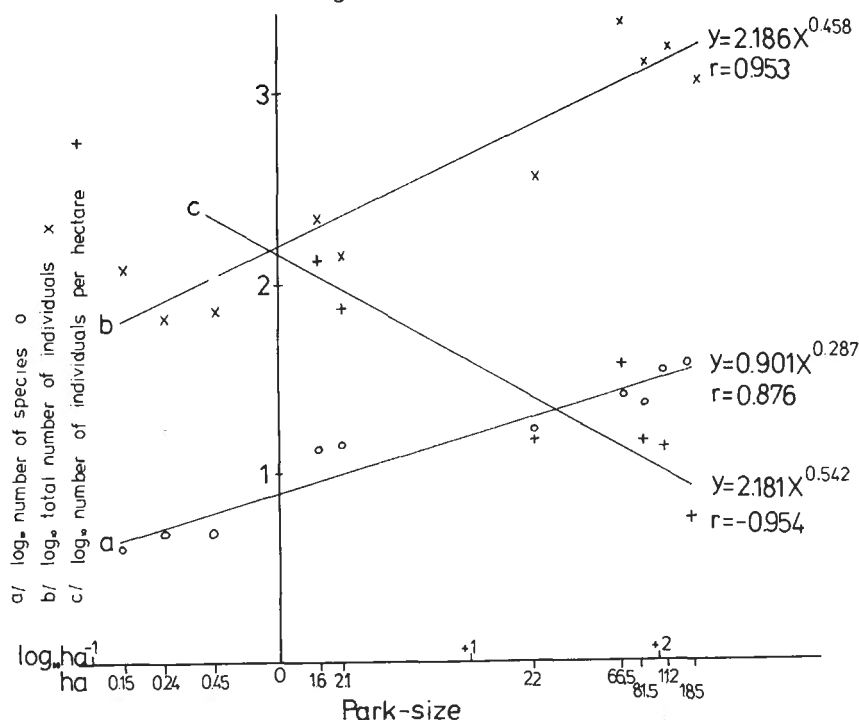


Fig. 2. Logarithmic relationship between the park size and the number of species (a), the total number of individuals (b) and the number of individuals per hectare (c) in winter season

highest values of diversity and equitability present the most extensive parks (Cemetery and People's Park) as favourable for the settlement of the birds. However, the number of individuals per hectare is too low in the Cemetery, and also the total number is lower than in People's Park of smaller extent and in Margaret Island which is much smaller.

Besides the domestic pigeon and the house sparrow, the species best adapted to urban conditions are the blackbird and the collared turtledove (Table 4). They built their nests in the smallest squares of the city and in the immediate vicinity of these. Also the great tit adapts well: it was observed to have its nests in the two larger downtown squares over 1 hectare in extent. There was only one pair each that nested, but as it is a territorial species, it would not have tolerated another breeding pair in a square of so small area anyhow. Similarly in small numbers of individuals did starling, house martin red-rumped swallow and jackdaw enter the squares of the inner town.

The species which demanded more foliage and were less adapted to the pressure of houses and other buildings occurred only in more spacious parks. (Table 4). The species appearing in the Margaret Island and the City Park demonstrate that artificially formed vegetation has to some degree regenerated nature even within the urban environment, since even birds nesting in forest can be found



Table 1. Bird species and abundance in the large parks of Budapest

		Cemetery			People's Park			Margaret Island			City Park		
		1975	1976	1977	1975	1976	1977	1975	1976	1977	1975	1976	1977
<i>Accipiter gentilis</i>	B	$\bar{x}$											
	SD												
	W	$\bar{x}$	.5	.5									
	SD	1		.7									
<i>Accipiter nisus</i>	W	$\bar{x}$		.5	1								
	SD												
<i>Buteo buteo</i>	B	$\bar{x}$	.5										
	SD		.7										
	W	$\bar{x}$	.5	.5									
	SD		.7	.7									
<i>Falco columbarius</i>	W	$\bar{x}$	.5	1.3	.5	1							.5
	SD	.7	.3	.7		0							.5
<i>Falco tinnunculus</i>	B	$\bar{x}$	2	2		.5	2						
	SD	0	0	0		.7	0						
	W	$\bar{x}$	1	1.5	1.5								.5
	SD	1.7	1.2	1.7									.7
<i>Perdix perdix</i>	B	$\bar{x}$	2	2.5	6.6								
	SD	0	2.1	.7									
	W	$\bar{x}$	3.5	7	10								
	SD	.7	2.8	4.2									
<i>Phasianus colchicus</i>	B	$\bar{x}$	3	10	5.5								
	SD	.7	1.4	2.8									
	W	$\bar{x}$	8	6	6.3								
	SD	1.4	0	.7									
<i>Streptopelia turtur</i>	B	$\bar{x}$	3	10.3	5.5	1	3						
	SD	1.4	2.8	2.1		1.4	1.7						



(Table 1.)

	Cemetery				People's Park				Margaret Island				City Park			
	1975	1976	1977		1975	1976	1977		1975	1976	1977		1975	1976	1977	
<i>Streptopelia decaocto</i>	B $\bar{x}$	35	13	36	104	59	57.5		72	59	115.5		22.5	27	37	
	SD	15.5	4.2	14.1	20.6	4.2	6.3		8.4	9.9	13.4		14.8	9.9	9.9	
	W $\bar{x}$	21.5	9.7	29	99	107.	58		88.5	52	72.5		32	13	20	
	SD	7.7	2.1	14.1	57.9	5.6	16.9		9.1	8.4	9.6		19.8	1.4	1.7	
<i>Cuculus canorus</i>	B $\bar{x}$	3	4	4												
	SD	1.4	2.8	1.7												
<i>Athene noctua</i>	B $\bar{x}$	2.6	2.2	2.5	2		2									
	SD	.5	1.5	.7	0		0									
<i>Strix aluco</i>	B $\bar{x}$	2														
	SD	0														
<i>Upupa epops</i>	B $\bar{x}$	2	1	4	2	1	3									
	SD	0	1.4	0	0	.7	1.4									
<i>Jynx torquilla</i>	B $\bar{x}$	5	4	3	2	1	2				2					
	SD	1.4	0	1.4	0	.7	0				0					
<i>Picus viridis</i>	B $\bar{x}$	3	5	2	3	2	5		2	2	2		2.5	2	4	
	SD	1.4	1.4	0	1.4	0	3.6		0	1.4	0		.7	0	0	
	W $\bar{x}$	2.5	4	3.5	4	3.5	4		3	4	2		2.5	3	3.5	
	SD	.7	0	.7	0	.7	0		.7	0	0		2.1	0	2.1	
<i>Dendrocopos major</i>	B $\bar{x}$	3	7	4.5	4.5	2	4.5		4	5.5	5		3	1.5	2	
	SD	1.7	1.4	7.	2.1	0	2.8		0	.7	1.4		1.4	.7	0	
	W $\bar{x}$	7	6	4	5	3	5.5		6	6.5	6		2.5	3	4	
	SD	1.4	2.8	0	2.8	2.8	3.5		0	2.1	2.8		.7	0	2.8	
<i>Dendrocopos syriacus</i>	B $\bar{x}$	2	1	2		.5	1.5		2	1.5	2					
	SD	0	1.4	0		.7	.7		0	1.2	0					
	W $\bar{x}$	3.5	1.5	3	1.5	1	2		3.5	2.5	3					
	SD	.7	1.3	1.4	1.2	0	0		.7	2.1	1.4					



(Table 1.)

	Cemetery				People's Park				Margaret Island				City Park			
	1976	1976	1977		1976	1976	1977		1975	1976	1977		1975	1976	1977	
<i>Dendrocopos medius</i>	B $\bar{x}$	2	2													
	SD	0	0													
	W $\bar{x}$	1.5	2	1.5												
	SD	.7	0	.7												
<i>Dendrocopos minor</i>	B $\bar{x}$		2		2		2									
	SD		0		0		0									
	W $\bar{x}$		2		2		2									
	SD		0		1.4		1.4									
<i>Galerida cristata</i>	B $\bar{x}$	4	4.5	3	2	3.5	4		2	3.5	2		6	4	4.5	
	SD	0	2.8	1.4	0	.7	0		0	.7	0		0	0	.7	
	W $\bar{x}$	9	7.5	6.5	5	9.5	8.5		3	4	4		8.5	3.5	9	
	SD	3.6	2.1	3.5	2.8	2.1	4.9		1.4	2.8	0		.7	2.1	2.8	
<i>Hirundo rustica</i>	B $\bar{x}$	4	6.5	3.5	5.5	5	7.5		6	5.5	6		9	8	6	
	SD	2.3	2.8	1.4	2.1	0	2.1		2.8	2.1	4.2		8.4	5.6	4.2	
<i>Delichon urbica</i>	B $\bar{x}$	23.3	18	14	3.5	17	15		18.5	14	17.5		12.5	10	16	
	SD	11.7	2.8	5.6	3.4	2.8	11.3		2.1	7	3.5		6.3	1.4	5.6	
<i>Oriolus oriolus</i>	B $\bar{x}$	7	8	7	3	5	3		2	2.5	2.5					
	SD	1.4	3.5	4.2	.7	1.4	1.2		1.4	.7	2.1					
<i>Corvus corone</i>	B $\bar{x}$	8.3	6	5.5	3	2	3		7	6	6		3	4	4	
	SD	3.5	2.8	2.1	.7	0	.7		4.2	5.6	5.6		1.4	0	2.8	
	W $\bar{x}$	5	4	4	3.5	2	5		12.5	6.5	6.5		2	3	4.5	
	SD	4.2	2.8	1.5	2.1	1.4	4.2		2.1	4.2	3.5		0	1.4	2.1	
<i>Corvus frugilegus</i>	W $\bar{x}$	63.5	40.3	42.7	132.7	118.5	89		105	55.5	144.7		45.7	110.7	50.5	
	SD	16.2	33.2	20.5	117.8	36.4	29.7		102.2	48.7	93.3		40.8	56.5	43.1	
<i>Coloeus monedula</i>	B $\bar{x}$	5	3	3.7	6	4	5.3		9.7	24	19.7		11.5	13.3	8	
	SD	3.2	1.7	1.4	2.8		4.2		7.3	16.9	2.4		6.3	3.5	.7	
	W $\bar{x}$	1.7	4.3	2	7.5	8	10.3		10	11.8	27.7		7	4.3	5.7	
	SD	.3	2.8	0	3.6	1.4	5.6		2.8	8.7	8.2		4.2	2.8	2.1	



(Table 1.)

	Cemetery						People's Park			Margaret Island			City Park		
	1975	1976	1977	1975	1976	1977	1975	1976	1977	1975	1976	1977	1975	1976	1977
<i>Pica pica</i>															
B $\bar{x}$	11.3	7.7	9.5	11.7	17.3	19.5				19	15.7	14.7	2.7	2.3	2
SD	1.7	4.6	7.3	.7	2.8	4.6				.7	.7	3.2	.5	1.2	0
W $\bar{x}$	13	12.5	7.7	13	14.7	14				1	2	3.7		5	3.3
SD	11.3	9.6	4.3	8.4	4.2	8.7				.4	1.7	.7		.5	2.8
<i>Garrulus glandarius</i>															
B $\bar{x}$	3.3	3.7	2	1.5	1	2.3									
SD	1.2	2.8	0	.7	.3	2.2									
W $\bar{x}$	5	3	4.7	4.5	2.5	2.3				2	2.3				
SD	4.2	1.6	2.8	4.2	1.7	1.2				1.7	1.2				
<i>Parus major</i>															
B $\bar{x}$	47.5	66	38.5	21.7	28	34				67	59	65.3	18	10.3	16.5
SD	33.2	14.1	26.1	1.7	8.4	8.6				32.5	21.2	33.1	2.8	6.2	12
W $\bar{x}$	38.5	44.7	25	43	24.5	38.3				59.7	60.3	83.5	43	27.7	15.5
SD	9.1	16.9	8.4	18.3	19	32.5				19.9	19	16.2	29.7	26.8	4.9
<i>Parus caeruleus</i>															
B $\bar{x}$	20	18.7	14	18.2	32.5	11				15.5	11.5	20.7	20.5	10.7	9.5
SD	11.3	8.4	12.3	7	5.6	7.7				13.4	9.1	12.5	8.7	9.9	4.9
W $\bar{x}$	18.7	8.3	12.5	11.5	9	7.5				20.7	12.5	23	11.5	7	12
SD	8.4	5.4	9.1	10.6	8.4	4.9				6.3	6.7	9.3	4.9	4.2	8.7
<i>Parus palustris</i>															
B $\bar{x}$	2	4	2.3	2	2	2									
SD	0	0	1.2	0	0	0									
W $\bar{x}$	2	4.5	2.5	1.5	2	2				1	3	2			
SD	0	.7	1.2	.5	0	1.4				.7	.7	1.4			
<i>Sitta europaea</i>															
B $\bar{x}$	9	9.7	5	9	6.7	9.3				16.3	10.3	17.5	4	2.3	3
SD	4.2	4.1	3.2	1.7	5.6	4.2				5.6	2.8	4.5	0	1.4	1.7
W $\bar{x}$	7	10.5	11	11.7	7.3	11.3				14.7	10.5	6.5	4.7	5.3	4.5
SD	1.4	4.9	1.7	.7	4.2	4.7				11.3	5.6	1.7	1.4	3.6	1.7
<i>Certhia brachydactyla</i>															
B $\bar{x}$	4	5.7	5	2	3.7	4.5				4	3	3.7	2	3.7	2
SD	3.2	3.6	2.3	0	1.3	3.7				3.6	1.7	.7	0	1.4	0
W $\bar{x}$	5	6.5	4	4.5	2	4				5.5	4.3	4.5	3.5	1.5	3
SD	4.2	3.5	3.2	2.7	0	0				4.7	3.6	1.3	.7	.5	1.5



(Table 1.)

	Cemetery			People's Park			Margaret Island			City Park		
	1975	1976	1977	1975	1976	1977	1975	1976	1977	1975	1976	1977
<i>Turdus viscivorus</i>	W $\bar{x}$	5	5	4	22.5	15.7	12	4	110	10.7	5.7	7.5
	SD	4.4	3.7	3.6	14.8	8.4	7.6	2.8	1.4	1.7	4.3	6.2
<i>Turdus pilaris</i>	W $\bar{x}$	40.5	15	46.7	78.7	56	94.5	24	25.8	10.6	9.5	11.7
	SD	9.1	8.4	22.6	55.7	38.2	77.4	5.6	9.9	7.4	8.6	10.6
<i>Turdus merula</i>	B $\bar{x}$	63.4	52.5	53.8	38.3	74	131.3	210.6	195.2	213.7	66.3	41.6
	SD	35.3	38.8	33.6	10.2	16.9	49	28.4	54.3	69.6	27.	30.2
	W $\bar{x}$	61.3	43.6	54.8	172	116.1	147.8	195.6	243.7	255	88	63
	SD	19.4	16.5	21.1	17.4	73.7	54.1	16.2	20.6	41.8	13.7	28.6
<i>Turdus philomelos</i>	B $\bar{x}$	6	4.7	4.3			2					
	SD	2	1.7	1.7								
<i>Oenanthe oenanthe</i>	B $\bar{x}$	2		3			2					
	SD	0		1.5			0					
<i>Phoenicurus ochruros</i>	B $\bar{x}$				2			2	1.7	2	2	2
	SD				0			0	1.5	0	0	0
<i>Luscinia megarhynchos</i>	B $\bar{x}$	21.5	13	17.7	3	4	4.5	3	2	4	1.5	2.5
	SD	10.6	4.2	10.2	1.4	0	3.2	1.2	0	0	.7	1.5
<i>Erithacus rubecula</i>	B $\bar{x}$	10.3	6.6	7.3	6	5.3	5	4	6.2	4.3	1.5	2
	SD	9	4.2	5.2	2	3.5	1.4	1.4	1.7	3.6	1.2	0
	W $\bar{x}$	6.3	5.7	5.6	5.6	2.6	8	4.5	7.3	6.6	1.5	2.4
	SD	1.5	3.6	3.2	3.5	2	5	1.4	4.6	4	.7	2.2
<i>Hippolais icterina</i>	B $\bar{x}$	2	3	4.2	2		3.5					
	SD	0	.5	3.6	0		2.2					
<i>Sylvia atricapilla</i>	B $\bar{x}$	19	19.3	14.6	0.6	16.3	9	14.3	23.6	13.6	3.6	8.6
	SD	2.8	12.2	5.6	5.5	2	5.4	7	3.5	6	3.2	3
<i>Sylvia nisoria</i>	B $\bar{x}$	2	2	3.5	1		1.7					
	SD	0	1	.5	.7		1.2					



(Table 1.)

		Cemetery			People's Park			Margaret Island			City Park		
		1975	1976	1977	1975	1976	1977	1975	1976	1977	1975	1976	1977
<i>Sylvia borin</i>	B $\bar{x}$ SD	3.7 1.2	4.5 1.2	1 .5				1 .5	2 0	.5			
<i>Sylvia communis</i>	B $\bar{x}$ SD	4 1.5	4.6 3.2	5.4 1	4.5 1.5	3 1.5	4 1.7	3.5 2.5	2.5 2.1	3 2.8	2 0	3 1.5	1.5 .7
<i>Sylvia curruca</i>	B $\bar{x}$ SD	4.6 1.7	5 3.2	6.6 3.7	3 1.2	4.2 2.8	4.2 3.2	2.3 1.5	4 0	3 1.2	2 .5	3.3 1.7	1.5 .7
<i>Philloscopus trochilus</i>	B $\bar{x}$ SD	5 3.6	4.5 3.2	6.3 3.2	1 .2	4.3 3.2	4 2	1 1	3 1	1.5 .7	3 1	2.3 .7	1 .7
<i>Philloscopus collybita</i>	B $\bar{x}$ SD	26.6 11.5	31.5 17.7	15.3 2.5	11.3 7.5	7.6 .3	14.6 5.6	3 1.1	1 .7	4 2	2 1.5	3 2	1 .5
<i>Philloscopus sibilatrix</i>	B $\bar{x}$ SD	5.6 1.5	3.6 .7	6.3 2.8	7.3 3.4	5.2 4.6	7.6 4.2	3 1.5	2 .7	1.5 1	4.3 2.8	2.5 1.2	2.3 1.2
<i>Regulus regulus</i>	W $\bar{x}$ SD	2.3 2.2	2.3 1.5		3.6 .5								
<i>Muscicapa striata</i>	B $\bar{x}$ SD				5.6	2	4.3	2		3.2		1.2	
<i>Muscicapa albicollis</i>	B $\bar{x}$ SD	3.3 1.1		1 .7	5.6 .5	2 1	4.3 1.2	2 1.5		3.2 1.7		1.2 .7	
<i>Motacilla alba</i>	B $\bar{x}$ SD	2 0	1.5 .7	2.2 1.7	1 .5	2.5 1.2	2.8 1.3						
<i>Bombycilla garrulus</i>	W $\bar{x}$ SD	8.6 4.2	14.4 8.5		16.6 10.6	7.4 6.3		22 11.1	10.3 8		31 9.5	14.5 5.5	
<i>Lanius excubitor</i>	W $\bar{x}$ SD	1 0	5 .2		.5 .2								



(Table 1.)

	Cemetery				People's Park				Margaret Island				City Park			
	1975	1976	1977		1975	1976	1977		1975	1976	1977		1975	1976	1977	
<i>Lanius collurio</i>	B	$\bar{x}$	1.5	2.6	2.6	2.3	1.6	1.5	1	.5						
	SD		.7	2.3	1.1	1.1	1.2	.5	.5							
<i>Sturnus vulgaris</i>	B	$\bar{x}$	34.6	25.3	43.2	57.5	43.7	60	35	18.7	35.5		14.5	29.1	24.5	
	SD		26.1	111.8	28.1	24.7	30.9	28.2	25.3	5.6	14.6		4.9	13.5	21.9	
<i>Passer domestic</i>	B	$\bar{x}$	60.5	48.2	61.5	46.7	75	160.5	464	245.5	434		262.7	209.4	232.8	
	SD		28.9	14.1	32.4	93.5	63.6	127.2	387.4	82.7	359.3		159.1	106.3	130.2	
	W	$\bar{x}$	37	56.5	55.4	76	190.5	96.5	641.8	270.3	517.3		418.7	179.2	335.1	
	SD		31.1	20.5	21.9	92.7	74	76	460.2	125.8	433.7		397.2	121.3	243.1	
<i>Passer montanus</i>	B	$\bar{x}$	192.5	85.8	163.6	16.5	115.7	129.7	242.4	220.5	311		69.7	61.5	47.5	
	SD		115.6	63.6	121.9	71.3	134.2	118.1	211	187.3	141.5		26.4	42.8	32.8	
	W	$\bar{x}$	265.4	80.8	291.5	91.2	359.4	425.1	250	415.7	172.5		22.4	36.7	24.7	
	SD		147.5	74.8	158.2	41.3	252	314.2	168.3	121.3	89.4		16.3	28.2	7	
<i>Coccothraustes coccothraustes</i>	B	$\bar{x}$	9	6	9.4	16	15.7	11.5	5.5	9.2	6.8		3	2	3.4	
	SD		4.2	5.6	3.7	8.2	7.3	6.5	2.8	3.7	4.2		2	1	1.7	
	W	$\bar{x}$	17.5	25	17.8	40	17.6	28.7	26.5	11.4	22.9		18.7	22.2	24.8	
	SD		3.5	3.8	2.1	17.2	3.6	13.7	14.8	4.7	18.6		13.7	18.8	16.6	
<i>Chloris chloris</i>	B	$\bar{x}$	29.7	34	32	26.7	14.8	21	12	20.4	23.8		14	14.6	15.2	
	SD		14	11.3	6.5	12.2	8.3	19.2	8.6	9.2	14.6		11.3	8.3	11.8	
	W	$\bar{x}$	17	36.5	18.5	32	17.4	31.5	23.5	14	17.5		8	22.5	10.5	
	SD		9.3	14.8	12	28.6	13.2	22.7	8.9	11.2	13.6		5.6	9.1	6.4	
<i>Carduelis spinus</i>	W	$\bar{x}$	5	2	5.3	15	11.5	6	3.5	4	5		6.5	3.2	2.5	
	SD		1.4	1	.7	2.8	5.6	3.5	1.5	2	2.5		4.8	1.7	1.5	
<i>Carduelis carduelis</i>	B	$\bar{x}$	8.2	9.3	5.3	3.5	7	9.3	3	4.7	5		5	8.4	6	
	SD		5.4	4.2	4.8	2.1	4.2	7.4	1.4	3.6	4.2		4.5	6.4	5.2	
	W	$\bar{x}$	20.5	27	19.7	14.5	12.3	11.6	2	4.5	6		8.7	7.3	4.2	
	SD		7.7	4.2	2.8	9.1	8.7	5.5	.7	3.2	5.7		5.6	6.6	2.8	



(Table 1.)

		Cemetery			People's Park			Margaret Island			City Park		
		1975	1976	1977	1975	1976	1977	1975	1976	1977	1975	1976	1977
<i>Acanthis cannabina</i>	B $\bar{x}$	11	25.7	2	2.5		1			2			
	SD	4.5	21.3	1.7	2.2		.5			0			
	W $\bar{x}$	3.7	4	9.3	4	2.5	3		1	3	1	2	
<i>Serinus serinus</i>	SD	2.8	2.8	7.7	2.5	1.7	1.5		.7	2.5	.5	0	
	B $\bar{x}$	6.4	3.7	4	2	5	4.6	2	1.5		2	2	
	SD	2.8	1.4	3.2	0	3.6	2.8	1.5	.5		0	0	
<i>Pyrrhula pyrrhula</i>	W $\bar{x}$	11.5	6.8	14.9	6.3	6.5	5.8	1.5	4	4	3.5	4	3.6
	SD	8.7	4.2	11.8	5.6	1.4	1.4	1.2	2	2.5	2.2	.7	.8
<i>Fringilla coelebs</i>	B $\bar{x}$	17	19.3	23.5	7.5	11	11.8	6	12.3	13.2	3	1.5	4.5
	SD	1.8	2.8	10.6	3.6	1.7	7.6	2.4	7.1	8.4	0	1.2	2.1
	W $\bar{x}$	10.5	14	13.7	28	17.7	32.5	11.5	17	22	14.5	9.7	11.5
<i>Emberiza citrinella</i>	SD	8.1	9.2	11	18.3	13.5	26.7	4.2	13.5	11.3	7.8	5.6	10.2
	B $\bar{x}$	2.5	1	2	2		1.5						
	SD	1.5	.5	0	0		1.2				1	1.7	
<i>Columba livia domestica</i>	W $\bar{x}$	2	2.5	5.3		2.5	4				.7	1.4	
	SD	1.4	1.5	4.6		2.2	2.5						
	B $\bar{x}$	10.5	28.7	15.5	65.5	30	64.2	88.5	55.1	124.7	91.5	65.3	69.8
	SD	4.5	13.8	10.7	15.5	20.2	59.7	74.5	25.8	27	61.5	45.7	49.5
	W $\bar{x}$	17.5	11	25.8	41	27.5	42.8	92	50.7	107.4	72.2	50.7	82.5
	SD	13.5	9.2	12.5	9.6	22.5	12.5	58.7	40.5	67.7	41	40.2	62.3

Notes: B = Breeding season

W = Winter season



Table 2. Bird species and abundance in

			Friendship Park			Museum Park			1975
			1975	1976	1977	1975	1976	1977	
<i>Falco tinnunculus</i>	W	$\bar{x}$ SD							
<i>Streptopelia decaocto</i>	B	$\bar{x}$ SD	6.5 .7	4.2 .7	5 2.8	12 6.7	8 4.2	13.7 5.6	6.5 3.8
	W	$\bar{x}$ SD	5 1.4	2 0	2.3 2.1	10 4.6	21.7 12.2	13 5.6	8 2.8
	B	$\bar{x}$ SD	2 0	1.5 .5	2 0				
	W	$\bar{x}$ SD	6 4.2	3.5 2.8	5.7 3.7	2 0	2 0	1 .5	2 1
<i>Hirundo rustica</i>	B	$\bar{x}$ SD	2 0	1 .7	3 1.7	2 1		1 0	2 1.4
	B	$\bar{x}$ SD	5.5 1.4	8 .5	5 2.7	2.5 .7	2 0	4 1.4	2 0
<i>Corvus corone</i>	W	$\bar{x}$ SD	.5 .5	1.5 .7	2 1	.5 .2		.5 .2	1 0
<i>Corvus frugilegus</i>	W	$\bar{x}$ SD	48 30.5	14.5 8.6	47 16.8	6 2.8	3 2.8	3.7 1.4	4 2.8
<i>Corvus monedula</i>	B	$\bar{x}$ SD				2 0		.5 .5	4 0
	W	$\bar{x}$ SD				1 .7		3.5 2.7	2 0
	W	$\bar{x}$ SD	1 .7		1.5 1.2				
	W	$\bar{x}$ SD							
<i>Parus major</i>	B	$\bar{x}$ SD		1 .7	1.5 .7	2 0		2 0	1.3 .7
	W	$\bar{x}$ SD	1 .7	1.5 .7	3.5 2.5	4.5 1.7	2 1.7	2.5 1.2	.5 .5
	W	$\bar{x}$ SD	1 .7	1 .5		3 1.7	2 1.5	2.5 1.7	.5 .3
	W	$\bar{x}$ SD							
<i>Sitta europea</i>	W	$\bar{x}$ SD	.5 .2	1 .7	1 .7				
	W	$\bar{x}$ SD	16 12.5	22.3 7.7	27.4 16.6	6 3.7	8 4.2	5.5 4.9	3 1.7
<i>Turdus pilaris</i>	B	$\bar{x}$ SD	3.6 3.2	3 1	4.3 2.6	8.3 3.2	10.3 1.5	9 3	10.6 4.5
	W	$\bar{x}$ SD							



*he small parks and squares of Budapest*

Angels Square		József Nádor Square			Vigadó Square			Vörösmarty Square		
1976	1977	1975	1976	1977	1975	1976	1977	1975	1976	1977
	.2				1	1				
	.5				.7	.7				
4.7	6.3	1	.5	1	2	2	3	3	3.7	1
1.2	5.1	.7	.5	.8	1	1.5	2.8	1.2	2.2	.7
11.7	8.5	4	3	2	2.5	2.5	2	2	2.8	2.2
9.2	.7	2.8	1.4	0	2.2	2.2	0	0	1.7	1.2
1										
.7										
	1									
	1									
4.5	4		2	.5	2.5	1	1.5	1.7	.7	.5
3.6	2		0	.2	1.5	1	.8	.3	.2	5.
.5										
.2										
2	5									
1.7	3.6									
3	3									
1.4	1.4									
4.5	2.5									
2.8	.7									
2	1									
0	.5									
3.5	1.5	1		.5	1		.7	1	.4	
1.7	1	.5		.2	.7		.3	1	.2	
3.2	1.7									
2.6	1.2									
5.5	7.6									
3.2	4.7									
7.6	11	1.5	2.5	2	1	1.2	1.5	2	1.5	1.5
5.2	3.6	.7	.2	0	0	.7	.2	0	.5	.7
21.5	17.5	2.5	3	2	.7	.5	.5	1	.5	1.5
3.7	6.1	1.2	1.8	0	.2	.3	.3	1	.5	.7



<i>Corvus frugilegus</i>	W	$\bar{x}$ SD	48 30.5	14.5 8.6	47 16.8	6 2.8	3 2.8	3.7 1.4	4 2.8	2 1.7
<i>Corvus monedula</i>	B	$\bar{x}$ SD				2 0		.5 .5	4 0	3 1.4
	W	$\bar{x}$ SD				1 .7		3.5 2.7	2 0	4.5 2.8
<i>Pica pica</i>	W	$\bar{x}$ SD	1 .7		1.5 1.2					
<i>Parus major</i>	B	$\bar{x}$ SD		1 .7	1.5 .7	2 0		2 0	1.3 .7	2 0
	W	$\bar{x}$ SD	1 .7	1.5 .7	3.5 2.5	4.5 1.7	2 1.7	2.5 1.2	.5 .5	3.5 1.7
<i>Parus caeruleus</i>	W	$\bar{x}$ SD	1 .7	1 .5		3 1.7	2 1.5	2.5 1.7	.5 .3	3.2 2.6
<i>Sitta europea</i>	W	$\bar{x}$ SD	.5 .2	1 .7	1 .7					
<i>Turdus pilaris</i>	W	$\bar{x}$ SD	16 12.5	22.3 7.7	27.4 16.6	6 3.7	8 4.2	5.5 4.9	3 1.7	5.5 3.2
<i>Turdus merula</i>	B	$\bar{x}$ SD	3.6 3.2	3 1	4.3 2.6	8.3 3.2	10.3 1.5	9 3	10.6 4.5	7.6 5.2
	W	$\bar{x}$ SD	8.6 1.7	6.3 5.2	4.3 2.7	8 6.5	17.6 8.2	11 7.9	16 2.8	21.5 3.7
<i>Erithacus rubecula</i>	W	$\bar{x}$ SD	1.5 .7	1 0	1.5 1					
<i>Bombycilla garrulus</i>	W	$\bar{x}$ SD	.5 .5	1 .3	.5	12.5 7.7	7 5.2	15.3	9.5 2.1	12 9.6
<i>Sturnus vulgaris</i>	B	$\bar{x}$ SD	4 2.8	5.5 1.4	6.3 1.8	3 1.4	1.5 1	4.8 2.3	5 4.2	3.3 1.7
<i>Passer domesticus</i>	B	$\bar{x}$ SD	27.5 10.6	35 21.3	24.5 18	54.5 34.6	40.7 28.2	39 12.7	86.5 37.8	112.7 63
	W	$\bar{x}$ SD	70 14.1	30.7 21.5	62.5 60.1	34.5 21	32.5 26.8	39 18.5	110.6 84	122.5 63.6
<i>Passer montanus</i>	B	$\bar{x}$ SD	11.5 9.9	6 5.6	11 8.4					
	W	$\bar{x}$ SD	61.5 49.9	42.5 33	48.7 39.4					
<i>Coccothraustes coccothraustes</i>	W	$\bar{x}$ SD	2 1.4	1 1	5 3.2	.5 .5	7.5 3.7	4 2	4 2.7	5.2 3.7
<i>Chloris chloris</i>	W	$\bar{x}$ SD	5.5 2.1	1.2 .7	4.5 .5	1 1	2 .5	1.5 .5	.5 .3	
<i>Carduelis carduelis</i>	W	$\bar{x}$ SD	2 0		2.5 .5					
<i>Carduelis spinus</i>	W	$\bar{x}$ SD	.5 .5		.5 .3					
<i>Emberiza citrinella</i>	W	$\bar{x}$ SD	.5 .3	2 0	1 0					
<i>Columba livia domestica</i>	B	$\bar{x}$ SD	15.7 4.5	30 14	16.7 6.9	16 12.8	19.5 12	23 4.2	59.5 47.2	47.3 35
	W	$\bar{x}$ SD	23 17.4	10 7.7	23.8 16.9	36.5 19	27 24.7	15.6 8.4	34 26.8	60 56

Notes: B = Breeding season

W = Winter season



	2	1.3	2	1									
	0	.7	0	.5									
2	2.5	.5	3.5	1.5	1		.5	1	.7	1	.4		
1.7	1.2	.5	1.7	1	.5		.2	.7	.3	1	.2		
2	2.5	.5	3.2	1.7									
1.5	1.7	.3	2.6	1.2									
8	5.5	3	5.5	7.6									
4.2	4.9	1.7	3.2	4.7									
10.3	9	10.6	7.6	11	1.5	2.5	2	1	1.2	1.5	2	1.5	1.5
1.5	3	4.5	5.2	3.6	.7	.2	0	0	.7	.2	0	.5	.7
17.6	11	16	21.5	17.5	2.5	3	2	.7	.5	.5	1	.5	1.5
8.2	7.9	2.8	3.7	6.1	1.2	1.8	0	.2	.3	.3	1	.5	.7
7	15.3	9.5	12										
5.2		2.1	9.6										
1.5	4.8	5	3.3	5.7				2	1	2.2			
1	2.3	4.2	1.7	4.6				0	.7	.7			
40.7	39	86.5	112.7	176	22.5	25	19.3	23	26.3	19.7	21.5	19	31.7
28.2	12.7	37.8	63	56.6	10.6	7.8	14.3	18.3	17	17.6	6.5	8.5	19.3
32.5	39	110.6	122.5	130	28	19	37.5	29.7	32	36.5	23.8	27.5	22
26.8	18.5	84	63.6	35.5	18.7	11.3	6.3	14.4	22.5	13.4	16.1	18.8	9.9
7.5	4	4	5.2	1									
3.7	2	2.7	3.7	.5									
2	1.5	.5		1									
.5	.5	.3		.3									
10.5	23	59.5	47.3	56.5	14.4	17	16.5	12.5	15	22.5	54	408.	28
12	4.2	47.2	35	32.6	12.7	10.6	8.6	7	10.6	7.7	8.4	32.4	18.3
27	15.6	34	60	47.8	25.5	12.6	14	19	17.5	24	38	20.7	49
24.7	8.4	26.8	56	31.1	19	8.7	12.7	17.8	3.5	12.8	26.6	14.1	15.6



among them. In the parks over 100 hectares, with the high volumes of foliage there even appeared species which had adhered most to their original natural environment (People's Park, Cemetery).

It should be mentioned as a peculiar phenomenon that, contrary to expectations, two species: the wren and the long-tailed tit did not occur at breeding time in the area under the census. The wren and the long-tailed tit occurred in the study parks only during the summer-autumn season.

## Conclusions

The cities and towns offer an extremely heterogeneous environment for the birds wanting, or — because they have not found a more suitable habitat — compelled to settle. Attempts had been made at classifying this environment (Bozsko, 1968; Strawinski, 1966; Erz, 1962), so that in this way also the birds adapted to the cities and towns could be grouped in ecological respect. Obviously, all ecological approaches emphasised the primary importance of vegetation in the settlement of the birds and in the favourable formation of the proportions of their species and individuals. That was also the reason why the present researches was restricted exclusively to squares and parks, that is: to study the bird fauna of the artificial vegetation concentrated on larger and smaller areas.

For an ornithological valuation of the parks of Budapest a comparison can be made with other investigation on the parks of Central and Northern Europe. These surveys inform on the park size, so they afford a possibility of comparing the number of bird species. Using Bozsko and Järvinen's comprehensive study and completing it with the present results, one can state once more that with the increase of the parks also the number of breeding species is increasing, although, according to the Budapest surveys the increase is much more moderate than could be expected relying upon the data of the literature (Table 5). The number of breeding species in the parks of Budapest has been lower than the one of the breeding species in the parks of approximately identical size of other European cities. (As to the number of individuals, no conclusions whatsoever can be drawn founded on the literature).

The census conducted through 3 years afford a possibility to give a prognosis on the avifauna of the parks to be established in the future. This prognosis can be valid mainly in the geographic area of Budapest and Central Europe, respectively although it may also help in drawing certain conclusions on cities situated farther off. As to be observed, the smaller or greater changes followed in the sequence of years did not disturb the differences appearing either in the individual or species composition among the parks, so that any year could have been taken as the sample of the prognosis. For determining the expectable number of species, total number of individuals and number of individuals per hectare taken as a function of park size, linear regression analysis carried out on the census in 1977 was used. The results of the calculation are summarized in Table 6.

Undoubtedly, our healthy environment can be maintained only if we insert as many and as extensive green spots as possible into the concrete jungles of the towns and cities. In this way nature can be retrieved to the bleakest technical world. Although this endeavour will at all times encounter numerous difficulties,



Table 3. Bird density and species diversity  
(B = breeding season,

		Cemetery			People's Park		
Park size in hectare:		185			112		
Years of census:		1975	1976	1977	1975	1976	1977
No. of species	B:	54	52	55	48	42	52
	W:	39	40	38	33	31	30
No. of individuals	B:	780.7	1065.4	708.7	1046.4	657.8	894
	W:	754.5	543.2	773.2	1185.4	1155	1200.5
No. of individuals per hectare	B:	4.2	5.7	3.8	9.3	5.8	7.9
	W:	4	2.9	4.2	10.6	10.3	10.7
$H_{\max}$	B:	3.989	3.951	4.007	3.871	3.738	3.951
	W:	3.664	3.689	3.638	3.497	3.434	3.401
Diversity $H'$	B:	3.102	2.375	2.932	2.577	2.963	2.900
	W:	2.602	3.082	2.557	2.664	2.339	2.370
Equitability $J^1$	B:	.778	.601	.732	.666	.793	.732
	W:	.724	.835	.703	.762	.681	.697

		Museum Park			Engels Square		
Park size in hectare:		2.1			1.6		
Years of census:		1975	1976	1977	1975	1976	1977
No. of species	B:	8	6	8	9	8	9
	W:	14	12	13	14	13	12
No. of individuals	B:	100.3	82	96	173.4	185.1	264.5
	W:	126	132.3	103.3	195.6	253.1	224.3
No. of individuals per hectare	B:	47.7	39	45.7	108.3	115.6	165.3
	W:	60	63	49.1	122.2	158.1	140.1
$H_{\max}$	B:	2.079	1.792	2.079	2.197	2.079	2.197
	W:	2.639	2.485	2.565	2.639	2.565	2.485
Diversity $H'$	B:	1.521	1.338	1.646	1.338	1.615	1.065
	W:	2.007	2.078	1.986	1.501	2.008	1.605
Equitability $J'$	B:	.732	.747	.799	.609	.777	.485
	W:	.761	.836	.774	.569	.783	.646



*in the parks and squares of Budapest*

*W = winter season)*

Margaret Island			City Park			Friendship Park		
66.5			81.5			22		
1975	1976	1977	1975	1976	1977	1975	1976	1977
35	38	39	33	31	34	11	10	10
29	28	27	26	24	27	20	17	18
1322.6	1046.1	1503.6	1002.2	565.4	626.3	78.3	95.2	79.3
1638.5	1325.4	1448	842.8	602.1	744.4	255.6	272	244.7
19.8	15.7	22.6	12.3	6.9	7.7	3.6	4.3	3.6
24.6	19.9	21.7	10.3	7.4	9.1	11.6	12.3	11.1
3 638	3.555	3.664	3.497	3.464	3.526	2.398	2.303	2.303
3.367	3.332	3.296	3.258	3.178	3.296	2.996	2.833	2.890
2.201	2.438	2.181	1.852	2.459	2.237	1.849	1.698	1 768
2.047	2.423	2.234	1.983	2.324	2.133	2.017	1.424	2.049
.605	.686	.595	.530	.716	.634	.771	.737	.768
.608	.727	.678	.609	.731	.647	.673	.503	.709

József Nádor Square			Vigadó Square			Vörösmarty Square		
0.45			0.24			0.12		
1975	1976	1977	1975	1976	1977	1975	1976	1977
5	5	6	7	6	7	6	6	5
4	4	4	5	5	4	4	4	4
40.4	47	39.8	44	46.5	51.1	83.2	66.1	62.7
60	37.6	55.5	52.9	52.5	63	64.5	51.5	74.7
89.7	104.4	88.4	183.3	193.7	212.9	693.3	550.8	522.5
133.3	83.9	123.3	220.4	222.9	262.5	537.5	429.1	622.5
1.609	1.609	1.792	1.946	1.792	1.946	1.792	1.792	1.609
1.386	1.386	1.386	1.609	1.609	1.386	1.386	1.386	1.386
.875	.910	1.072	1.552	1.085	1.295	.972	.985	.887
1.034	1.115	.852	.966	.935	.833	.854	.904	.818
.545	.566	.599	.798	.605	.665	.542	.550	.551
.746	.805	.615	.602	.581	.601	.616	.652	.590



Table 4. The settlement of the bird species in breeding season as a function of park size

The species settled in the smaller downtown parks (under 3 ha), well adapted to the urban conditions.	The species settled in the more extensive parks (up to a 100 hectares), adapting to urban environment only if there was a considerable vegetation cover	Species settling in parks over 100 hectares, ones which adhered most to their original natural environment
---	---	--

<i>Streptopelia decaocto</i>	<i>Falco tinnunculus</i>	<i>Buteo buteo</i>
<i>Hirundo rustica</i>	<i>Jynx torquilla</i>	<i>Perdix perdix</i>
<i>Delichon urbica</i>	<i>Picus viridis</i>	<i>Phasianus colchicus</i>
<i>Coloeus monedula</i>	<i>Dendrocopos major</i>	<i>Streptopelia turtur</i>
<i>Parus major</i>	<i>Dendrocopos syriacus</i>	<i>Cuculus canorus</i>
<i>Turdus merula</i>	<i>Galerida cristata</i>	<i>Athene noctua</i>
<i>Sturnus vulgaris</i>	<i>Oriolus oriolus</i>	<i>Strix aluco</i>
<i>Passer domesticus</i>	<i>Corvus corone</i>	<i>Upupa epops</i>
<i>Columba livia domestica</i>	<i>Pica pica</i>	<i>Dendrocopos medius</i>
	<i>Parus caeruleus</i>	<i>Dendrocopos minor</i>
	<i>Sitta europaea</i>	<i>Garrulus glandarius</i>
	<i>Certhia brachydactyla</i>	<i>Parus palustris</i>
	<i>Phoenicurus ochruros</i>	<i>Turdus philomelos</i>
	<i>Luscinia megarhynchos</i>	<i>Oenanthe oenanthe</i>
	<i>Erithacus rubecula</i>	<i>Hippolais icterina</i>
	<i>Sylvia atricapilla</i>	<i>Sylvia nisoria</i>
	<i>Sylvia borin</i>	<i>Motacilla alba</i>
	<i>Sylvia communis</i>	<i>Acanthus cannabina</i>
	<i>Sylvia curruca</i>	<i>Emberiza citrinella</i>
	<i>Phylloscopus trochilus</i>	
	<i>Phylloscopus collybita</i>	
	<i>Phylloscopus sibilatrix</i>	
	<i>Muscicapa albicollis</i>	
	<i>Lanius collurio</i>	
	<i>Passer montanus</i>	
	<i>Coccothraustes coccothraustes</i>	
	<i>Chloris chloris</i>	
	<i>Carduelis carduelis</i>	
	<i>Serinus serinus</i>	
	<i>Fringilla coelebs</i>	

people will maybe give heed to ornithologists speaking up for the parks to be set up and also telling the size, compared to which only larger green areas may be established.



Table 5. The number of species and the number of individuals per hectare of the birds nesting in the parks in some European towns and in Budapest. (Data in Budapest were registered in 1977)

Name of the park	Town	Park size in hectare	No. of species	No. of individuals per hectare	Author
Vörösmarty Square	Budapest (Hungary)	0.12	5		
Vigadó Square	Budapest (Hungary)	0.24	7		
József Nádor Square	Budapest (Hungary)	0.48	6		
Engels Square	Budapest (Hungary)	1.6	9	165	
Museum Park	Budapest (Hungary)	2.1	8	46	
Zoo	Poznan (Poland)	5.25	18	50 — 60	MROCZKI- EWICZ, 1962
Zoo	Frankfurt/M (GFR)	7.6	21	30 — 40	STEINBA- CHER, 1942
Summer Garden	Leningrad (USSR)	11.7	14	1.4 (without sparrows)	BOZSKO, 1957
Zelenec Park	Torun (Poland)	11	26		STRAWINSKI, 1963
Solack Park	Poznan (Poland)	12	27	24	GRACZYK, 1952
Cemetery	Rostock (GDR)	17	28	18	GREMPE, 1973
Friendship Park	Budapest (Hungary)	22	10	4	
Tavritsheski Garden	Leningrad (USSR)	22	10	1 (without sparrows)	BOZSKO, 1967
Botanic Garden	Leningrad (USSR)	23.8	29	6 (without sparrows)	BOZSKO, 1967
Suburban Park	Lancut (Poland)	31	50	19	KALCZYCKI, 1966
Academic Park	Leningrad (USSR)	46	43	14	MALTSHEVS- KI, 1950
Margaret Island	Budapest (Hungary)	66.5	39	23	
City Park	Budapest (Hungary)	81.5	34	8	
Park of Biological Institut	Leningrad (USSR)	102	52	20 — 30	BOZSKO, 1957
People's Park	Budapest (Hungary)	112	52	8	
Oranienbaum Park	Leningrad (USSR)	162	67		BOZSKO, 1957
Cemetery	Budapest (Hungary)	185	55	4	
Botanic Garden	Debrecen (Hungary)	13.7	36		BOZSKO, 1968

*Number of species and number of individuals without information on park size*

Name of the park	Town	No. of species	No. of individuals per hectare	Author
City Parks (!)	Helsinki (Finland)	24		KAJOSTE, 1961
Scytnicki Park	Wroclaw (Poland)		52	SYRCZ, 1963
Ostankino Park	Moskwa (USSR)		1	KROTOV, 1941
City Parks (!)	Kiel (GFR)		12	ERZ, 1964
Zoo	Köln (GFR)		26	ERZ, 1964
City Park	Dortmund (GFR)		26	ERZ, 1964



Table 6. The prospective bird density in the parks to be established, represented as a function of park size in the breeding season

Park size in hectare	Number of species	Number of individuals	Individuals per hectare
1	7	89	89
5	12	195	38.1
10	14	276	27.6
20	18	358	17.9
30	21	460	15.3
40	22	520	13
50	24	565	11.3
70	28	660	9.4
100	31	870	8.7

### Acknowledgement

I thank the Park Maintenance Department of the Budapest Gardening Enterprise for support of the present work.

### REFERENCES

1. BOZSKO, SZ. (1957): *Ornithofauna parkor Leningrada i ego orkestrnostej*. — Vestn. LGU, 15., Ser. Biol., V, 3: 38–52.
2. BOZSKO, SZ. (1968): *A városi parkok, mint ökológiai egységek és ornithofaunisztikai jellemzésük*. — Aquila, 75: 131–149.
3. ENGSTRÖM, K. (1956): *Stockholms fågelliv*. — Stockholm, 148.
4. ERZ, W. (1964): *Bemerkungen über Charakteristika in der Verständerung westfälischer Vögel*. — Natur u. Heimat, Münster, Westf., 24: 107–117.
5. ERZ, W. (1966): *Ecological principles in the urbanization of birds*. — Ostrich, Suppl., 6: 357–363.
6. FITTER, R. (1949): *London's birds*. — London, 121.
7. FRIELING, H. (1942): *Großstadtvögel*. — Stuttgart.
8. GLADKOV, N. A. (1958): *Über die Vogelfauna der Kulturlandschaft*. — Proc. XII. Int. Orn. Congr. Helsinki, 234–239.
9. GRACZYK, R. (1952): *Ptaki w Solackim w Poznaniu*. — Chronmy Pr. Ojez., 8, 4.
10. GRIMM, H.: *Die Vogelwelt der Großstadt und der Industrielandschaft*. — Falke, 19: 150–156.
11. HERMS, E. (1950): *Das Vogelleben Bangkoks*. — Columba, 2: 75–76.
12. KAJOSTE, E. (1961): *Über die Nistvogelfauna der Innenstadt von Helsinki*. — Orn. Fenn., 38: 45–61.
13. KEVE, A. (1976): *Gondolatok a madarak urbanizációs kérdéséhez*. — Állattani Közlemények, 63: 83–94.
14. LEGENDRE, M. (1930): *Oiseaux de Paris*. — L'oiseau, 11: 378.
15. LUNIAK, M., KALBARCZYK, W. & PAWLOWSKI, W. (1964): *Birds of Warsaw*. — Acta Orn. PAN, 8: 175–285.



16. MACPHERSON, A. H. (1929): *A list of the birds of inner London.* — British Birds, 22: 222 — 244.
17. MALCHEVSKIJ, A. C. (1950): *O gnezdovanii ptic v gorodskih uslovijah.* — Tr. Leningr. Estestvoisp., 70, 4: 140 — 154.
18. MARSCHALL, A. F. & PELZEN, A. (1882): *Ornis Vindobonensis.* — Wien: 192.
19. MROCZKIEWICZ, D. (1962): *Oecology of free-living birds on the grounds of the Poznan Zoological Garden.*
20. PARK, R. E., BURGESS, E. W. & MCKENZIE, R. D. (1925): *The City.* — Chicago.
21. PATRIZI — MONTORO, F. (1909): *Materiali per un avifauna delle provincia di Roma.* — Bull. Soc. Zool. Ital.: 1 — 103.
22. RITCHIE, J. (1920): *The influence of man on animal life in Scotland.* — Edinburgh.
23. SCHNURRE, O. (1921): *Die Vögel der deutschen Kulturlandschaft.* — Marburg a. L.: 136.
24. STEINBACHER, G. (1942): *Siedlungsdichte in der Parklandschaft.* — Journal für Ornithologie, 90: 34 — 43.
25. STRAWINSKI, S. (1963): *The birds of Torun.* — Acta Ornithologica PAN, 7: 115 — 156.
26. STRAWINSKI, S. (1966): *Die Vögelverstädterung vom ökologischer Stadtpunkt.* — Ornithologische Mitteilungen, 18: 44 — 55.
27. WARD, P. (1968): *Origin of the Avifauna of Urban and Suburban Singapore.* — Ibis, 110: 239 — 255.